

WHAT IS CLAIMED IS:

- 1           1.       A method for processing packets from an Input/Output (I/O) device,  
2       comprising:  
3           maintaining information indicating a first buffer and second buffer for use with  
4       each descriptor, wherein one of the first and second buffers is assigned to the descriptor  
5       used by the I/O device, and wherein the I/O device write packets to the buffers assigned  
6       to the descriptors;  
7           accessing the first buffer including a packet from the I/O device, wherein the  
8       accessed first buffer is assigned to an accessed descriptor;  
9           processing the packet in the accessed first buffer; and  
10          if the second buffer assigned to the accessed descriptor is available, then updating  
11       information for the accessed descriptor to indicate that the second buffer is assigned to  
12       the accessed descriptor before completing the processing of the packet in the first buffer.
- 1           2.       The method of claim 1, further comprising:  
2           after completing the processing of the packet in the first buffer, indicating that the  
3       first buffer is available for assignment to the accessed descriptor.
- 1           3.       The method of claim 1, further comprising:  
2           if the second buffer assigned to the accessed descriptor is not available when  
3       proceeding to process the packet in the buffer, then copying the packet in the first buffer  
4       to a temporary buffer to process; and  
5           after copying the packet in the first buffer to the temporary buffer, updating  
6       information for the accessed descriptor used by the I/O device to indicate that the first  
7       buffer is assigned to the descriptor and available for use by the I/O device.
- 1           4.       The method of claim 3, wherein the operations of accessing the first  
2       buffer, copying the packet in the first buffer to the temporary buffer, and updating  
3       information for the accessed descriptor to indicate that the first buffer is assigned to the  
4       accessed descriptor and available are performed on a single thread of execution.

1           5.       The method of claim 4, wherein the operations of accessing the first buffer  
2     and updating information for the accessed descriptor to indicate that the first buffer is  
3     assigned to the accessed descriptor and available are performed by an interrupt handler  
4     invoked in response to an interrupt signal from the I/O device and the operation of  
5     copying the packet in the first buffer to the temporary buffer is performed by a protocol  
6     driver.

1           6.       The method of claim 5, further comprising:  
2             returning, by the protocol driver, the first buffer to the interrupt handler after  
3     copying the packet in the first buffer to the temporary buffer, wherein the interrupt  
4     handler updates information for the accessed descriptor to indicate that the first buffer is  
5     assigned to the accessed descriptor and available for use by the I/O device.

1           7.       The method of claim 1, wherein processing the packet in the first buffer  
2     comprises:  
3             calling a protocol driver to process the packet in the first buffer, wherein the  
4     protocol driver spawns a protocol thread to process the packet and wherein the protocol  
5     thread calls a function to indicate that the first buffer is available for assignment to the  
6     accessed descriptor after completing the copying of the first packet in the first buffer.

1           8.       The method of claim 1, wherein the I/O device comprises a network  
2     adapter that writes packets directly to buffers assigned to descriptors that are indicated as  
3     available, further comprising:  
4             generating an interrupt signal, with the I/O device, after writing at least one  
5     packet to at least one buffer assigned to at least one descriptor, wherein the first buffer  
6     including the packet is accessed after the interrupt signal is received.

1           9.       The method of claim 1, wherein there are at least two buffers for each  
2     descriptor.

1           10.     The method of claim 1, wherein for each descriptor there is one software  
2     descriptor and one hardware descriptor, wherein the software descriptor indicates the first  
3     and second buffers capable of being assigned to the descriptor and the hardware  
4     descriptor indicates one buffer assigned to the descriptor and the availability of the buffer  
5     assigned to the descriptor to receive data from the I/O device.

1           11.     A system, comprising:  
2     a processor;  
3     a storage device;  
4     an Input/Output (I/O) device;  
5     a storage controller for managing access to the storage device;  
6     at least one program that when executed by the processor performs:  
7                 (i) maintain information indicating a first buffer and second buffer for use  
8     with each descriptor, wherein one of the first and second buffers is assigned to the  
9     descriptor used by the I/O device, and wherein the I/O device write packets to the  
10    buffers assigned to the descriptors;  
11                (ii) access the first buffer including a packet from the I/O device, wherein  
12    the accessed first buffer is assigned to an accessed descriptor;  
13                (iii) process the packet in the accessed first buffer; and  
14                (iv) if the second buffer assigned to the accessed descriptor is available,  
15    then update information for the accessed descriptor to indicate that the second  
16    buffer is assigned to the accessed descriptor before completing the processing of  
17    the packet in the first buffer.

1           12.     The system of claim 11, wherein the at least one program that when  
2     executed by the processor further performs:  
3     after completing the processing of the packet in the first buffer, indicate that the  
4     first buffer is available for assignment to the accessed descriptor.

1           13.     The system of claim 11, wherein the at least one program that when  
2     executed by the processor further performs:

3           if the second buffer assigned to the accessed descriptor is not available when  
4     proceeding to process the packet in the buffer, then copy the packet in the first buffer to a  
5     temporary buffer to process; and  
6           after copying the packet in the first buffer to the temporary buffer, update  
7     information for the accessed descriptor used by the I/O device to indicate that the first  
8     buffer is assigned to the descriptor and available for use by the I/O device.

1           14.     The system of claim 13, wherein the operations of accessing the first  
2     buffer, copying the packet in the first buffer to the temporary buffer, and updating  
3     information for the accessed descriptor to indicate that the first buffer is assigned to the  
4     accessed descriptor and available are performed on a single thread of execution.

1           15.     The system of claim 14, wherein the at least one program includes an  
2     interrupt handler, invoked in response to an interrupt signal from the I/O device, to  
3     perform the operations of accessing the first buffer and updating information for the  
4     accessed descriptor to indicate that the first buffer is assigned to the accessed descriptor  
5     and available are performed and wherein the at least one program includes a protocol  
6     driver to perform the operation of copying the packet in the first buffer to the temporary  
7     buffer.

1           16.     The system of claim 15, wherein the protocol driver further performs:  
2           return the first buffer to the interrupt handler after copying the packet in the first  
3     buffer to the temporary buffer, wherein the interrupt handler updates information for the  
4     accessed descriptor to indicate that the first buffer is assigned to the accessed descriptor  
5     and available for use by the I/O device.

1           17.     The system of claim 11, wherein processing the packet in the first buffer  
2     comprises:  
3           calling a protocol driver to process the packet in the first buffer, wherein the  
4     protocol driver spawns a protocol thread to process the packet and wherein the protocol

5 thread calls a function to indicate that the first buffer is available for assignment to the  
6 accessed descriptor after completing the copying of the first packet in the first buffer.

1 18. The system of claim 11, wherein the I/O device comprises a network  
2 adapter that writes packets directly to buffers assigned to descriptors that are indicated as  
3 available, wherein the I/O device performs:

4 generate an interrupt signal ,after writing at least one packet to at least one buffer  
5 assigned to at least one descriptor, wherein the first buffer including the packet is  
6 accessed after the interrupt signal is received.

1 19. The system of claim 11, wherein there are at least two buffers for each  
2 descriptor.

1 20. The system of claim 11, wherein for each descriptor there is one software  
2 descriptor and one hardware descriptor, wherein the software descriptor indicates the first  
3 and second buffers capable of being assigned to the descriptor and the hardware  
4 descriptor indicates one buffer assigned to the descriptor and the availability of the buffer  
5 assigned to the descriptor to receive data from the I/O device.

1 21. An article of manufacture for processing packets from an Input/Output  
2 (I/O) device, wherein the article of manufacture causes operations to be performed, the  
3 operations comprising:

4 maintaining information indicating a first buffer and second buffer for use with  
5 each descriptor, wherein one of the first and second buffers is assigned to the descriptor  
6 used by the I/O device, and wherein the I/O device write packets to the buffers assigned  
7 to the descriptors;

8 accessing the first buffer including a packet from the I/O device, wherein the  
9 accessed first buffer is assigned to an accessed descriptor;

10 processing the packet in the accessed first buffer; and

11           if the second buffer assigned to the accessed descriptor is available, then updating  
12 information for the accessed descriptor to indicate that the second buffer is assigned to  
13 the accessed descriptor before completing the processing of the packet in the first buffer.

1           22.     The article of manufacture of claim 21, wherein the operations further  
2 comprise:  
3           after completing the processing of the packet in the first buffer, indicating that the  
4 first buffer is available for assignment to the accessed descriptor.

1           23.     The article of manufacture of claim 21, wherein the operations further  
2 comprise:  
3           if the second buffer assigned to the accessed descriptor is not available when  
4 proceeding to process the packet in the buffer, then copying the packet in the first buffer  
5 to a temporary buffer to process; and  
6           after copying the packet in the first buffer to the temporary buffer, updating  
7 information for the accessed descriptor used by the I/O device to indicate that the first  
8 buffer is assigned to the descriptor and available for use by the I/O device.

1           24.     The article of manufacture of claim 23, wherein the operations of  
2 accessing the first buffer, copying the packet in the first buffer to the temporary buffer,  
3 and updating information for the accessed descriptor to indicate that the first buffer is  
4 assigned to the accessed descriptor and available are performed on a single thread of  
5 execution.

1           25.     The article of manufacture of claim 24, wherein the operations of  
2 accessing the first buffer and updating information for the accessed descriptor to indicate  
3 that the first buffer is assigned to the accessed descriptor and available are performed by  
4 an interrupt handler invoked in response to an interrupt signal from the I/O device and the  
5 operation of copying the packet in the first buffer to the temporary buffer is performed by  
6 a protocol driver.

1           26.    The article of manufacture of claim 25, wherein the operations further  
2   comprise:

3                returning, by the protocol driver, the first buffer to the interrupt handler after  
4   copying the packet in the first buffer to the temporary buffer, wherein the interrupt  
5   handler updates information for the accessed descriptor to indicate that the first buffer is  
6   assigned to the accessed descriptor and available for use by the I/O device.

1           27.    The article of manufacture of claim 21, wherein processing the packet in  
2   the first buffer comprises:

3                calling a protocol driver to process the packet in the first buffer, wherein the  
4   protocol driver spawns a protocol thread to process the packet and wherein the protocol  
5   thread calls a function to indicate that the first buffer is available for assignment to the  
6   accessed descriptor after completing the copying of the first packet in the first buffer.

1           28.    The article of manufacture of claim 21, wherein the I/O device comprises  
2   a network adapter that writes packets directly to buffers assigned to descriptors that are  
3   indicated as available, wherein the operations further comprise:

4                generating an interrupt signal, with the I/O device, after writing at least one  
5   packet to at least one buffer assigned to at least one descriptor, wherein the first buffer  
6   including the packet is accessed after the interrupt signal is received.

1           29.    The article of manufacture of claim 21, wherein there are at least two  
2   buffers for each descriptor.

1           30.    The article of manufacture of claim 21, wherein for each descriptor there  
2   is one software descriptor and one hardware descriptor, wherein the software descriptor  
3   indicates the first and second buffers capable of being assigned to the descriptor and the  
4   hardware descriptor indicates one buffer assigned to the descriptor and the availability of  
5   the buffer assigned to the descriptor to receive data from the I/O device